To: Dave Noonan
From: Craig Swanson <cswanson@appsci.com>
Subject: Response to your question
Cc: Ted Barten
Bcc:
Attached: T:\ASA Contracts Directory\2002\02-200 Weavers Cove Modeling\Communications\Agency Comments\MADEP Noonan June 2006\ASA Response to David Noonan.pdf;


Dave:
I have drafted up a response to your question about possible problems with SSFATE in the NYNJ Newark application.  As you will see in the attached document there are none.  I appreciate your careful review of our work.
Craig

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**Craig Swanson, PhD___Applied Science Associates**
**70 Dean Knauss Drive**, **Narragansett, RI   02882  USA**
**voice: 401-789-6224_____fax: 401-789-1932**
**cswanson@appsci.com_____www.appsci.com**
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## ASA Response to David Noonan's Question of 17 July 2006

Question:  When I was doing some research on the SSFATE model, I came across the NY/NJ Harbor Dredging Arthur Kill project. It seems that SSFATE was not conserving (water) mass correctly and giving incorrect results (June 2005). My understanding is that there was a disconnect between SSFATE and the hydrodynamic model they linked it to. Did you have any problems with SSFATE conserving mass for the Weaver Cove work?

**Answer:  We did not have any problems with SSFATE conserving mass for the Weavers Cove work.  In fact we have had no problems with mass conservation in SSFATE for any of the many dredging and jet plowing applications we have performed nor do we know of any problems encountered by the Engineer Research and Development Center (ERDC) of the US Army Corps of Engineers (USACE) who also have applied the model many times.  The reason that SSFATE has no mass conservation problems is due to its basic formulation.**

**SSFATE is a Lagrangian calculation which means that particles are used in the model and are transported by advection (from hydrodynamic model output) and diffusion (a random walk formulation is used here).  It is very straightforward to ascertain that SSFATE conserves sediment mass because each particle is initially assigned a mass as it is introduced in the calculation and the mass of each particle does not change during the simulation.  The hydrodynamic models we and ERDC use generate mass-conserved velocities which are directly input to SSFATE.**

**The problem that was alluded to in the document you found, as Appendix A (Evaluation of SSFATE Modeling for Newark Bay) in USACE-NYD (2006) speculating that water mass was not conserved.  Either the hydrodynamic model used was not conservative or that the linkage between the hydrodynamic model and SSFATE created nonconservative model input.  If the hydrodynamics are not conservative then SSFATE can be expected to give unrealistic results.  SSFATE functioned properly but it does require that the input hydrodynamics conserve water mass.**

**The Appendix A document (attached to this document for easy reference) suggested that the coupling between the hydrodynamic model and SSFATE was flawed.  Based on the SSFATE model results described we concur.  The original SSFATE modeling report (NYNJ Harbor Partnership, 2003) stated (pg 2) that "SSFATE assumes a depth-averaged hydrodynamic solution" which is untrue.  They also admitted (pg. 2) that "only the top layer of the [hydrodynamic] model was used as input to SSFATE…for the purposes of predicting sediment suspension and transport, this approach is conservative."  We do not agree that this approach is necessarily conservative.**

**It should be noted that there are special situations where higher concentrations of sediments can develop away from the dredging operation.  For instance if particles are settling from upper layers of the water column to the bottom layer and the bottom layer velocity is sufficiently high to prevent deposition on the bottom then the particle density will increase which will manifest itself as an increased concentration.**

**The last paragraph of the attached Appendix A document says that a revised version of SSFATE will be used for a "revisit" of the Newark Bay application.  In fact SSFATE was updated but no changes were made to the basic model code since none were necessary.  The changes to SSFATE improved the user interface to the underlying model.**

**ASA had originally developed SSFATE for the USACE with the agreement that USACE personnel would have free use of the model but that non USACE personnel such as support contractors would not.  It appears that the agreement was violated in this case since the author of the original SSFATE modeling report (NYNJ Harbor Partnership, 2003) is a joint venture of Moffatt & Nichol Engineers, Inc. and Lawler, Matusky and Skelly**

Engineers, LLP.  ASA does not know any of the details of how they configured the linkage between their hydrodynamic model and SSFATE and suspect it was done incorrectly.  In fact the Appendix A document suggests in the third paragraph that the linkage or "method of model coupling would be likely to cause water mass not to be conserved."

References

NYNJ Harbor Partnership, 2003. SSFATE modeling of Arthur Kill dredging. Final Report, June 2003.

USACE-NYD, 2006.  Amendment to the environmental assessment on the Newark Bay area of the New York and New Jersey Harbor Deepening Project Volume II.  US Army Corps of Engineers, New York District, January 2006.

# APPENDIX A
# EVALUATION OF SSFATE MODELING FOR NEWARK BAY

U.S Army Corps of Engineers
New York District

Draft Amendment to DEA on the
Newark Bay Area of the NY and
NJ Harbor Deepening Project

# APPENDIX A
# EVALUATION OF SSFATE MODELING FOR NEWARK BAY

The results of the study "SSFATE Modeling of Arthur Kill Dredging, Final Report", by New York/New Jersey Harbor Partnership (NYNJ Harbor Partnership 2003) do not provide reliable estimates of the extent of dispersal and subsequent deposition of suspended material due to dredging. This is because the model does not appear to function properly.

Model results show local accumulations of solids in the water column at locations at some distance from the dredge. For example, in Figure 7-2 of NYNJ Harbor Partnership (2003), segments colored yellow and orange are present in Upper New York Bay just south of Kill van Kull on the western side of the channel (90 kg/m3 release rate). Such high concentrations are not observed at any depth in nearby areas of the bay or towards the eastern end of Kill van Kull. This means that this local high concentration does not appear to represent a plume of high-concentration water emanating from the dredge. Instead, solids appear to have increased in concentration in this local area. Such a local increase in TSS could occur only due to locally elevated settling rates. However, the elevated TSS levels occur in the 2 to 4m depth, that is, not near the bottom. This result suggests the possibility that the model is not conserving water mass, and thus that model results are an artifact of the how the model was developed.

This apparently counter-intuitive result may be related to the way in which the three-dimensional hydrodynamic model was coupled to SSFATE. Surface flows from the hydrodynamic model (USACE 1999) were apparently used in SSFATE for all depths within the water column. In an estuary with complex three-dimensional circulation and complex bathymetry, this method of model coupling would be likely to cause water mass not to be conserved.

ERDC plans to revisit the application of SSFATE to the Newark Bay area. The planned effort will rely upon (1) a revised version of the model SSFATE; (2) the incorporation of additional resuspension data; and (3) corrected application of hydrodynamic model results.

U.S Army Corps of Engineers
New York District

Draft Addendum to EA on the
Newark Bay Area of the NY and
NJ Harbor Deepening Project

*References*

NYNJ Harbor Partnership, 2003. *SSFATE Modeling of Arthur Kill Dredging.* Final Report, June 2003.

U.S. Army Corps of Engineers, 1999. *New York/New Jersey Harbor Navigation Study Hydrodynamic and Water Quality Modeling:* Preliminary Draft Final Report.